Resistant bacteria to antibiotics in the food chain: A cause for global food safety concern

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Antibiotics

- Antibiotics are the most therapeutic agents used in animal food producing
- Bacterial resistance: Spread among the food chain and the environment
- Pathogens (*Salmonella*, *Campylobacter*, *E.coli*, *Staphylococcus aureus*)
- Commensal bacteria (reservoir)

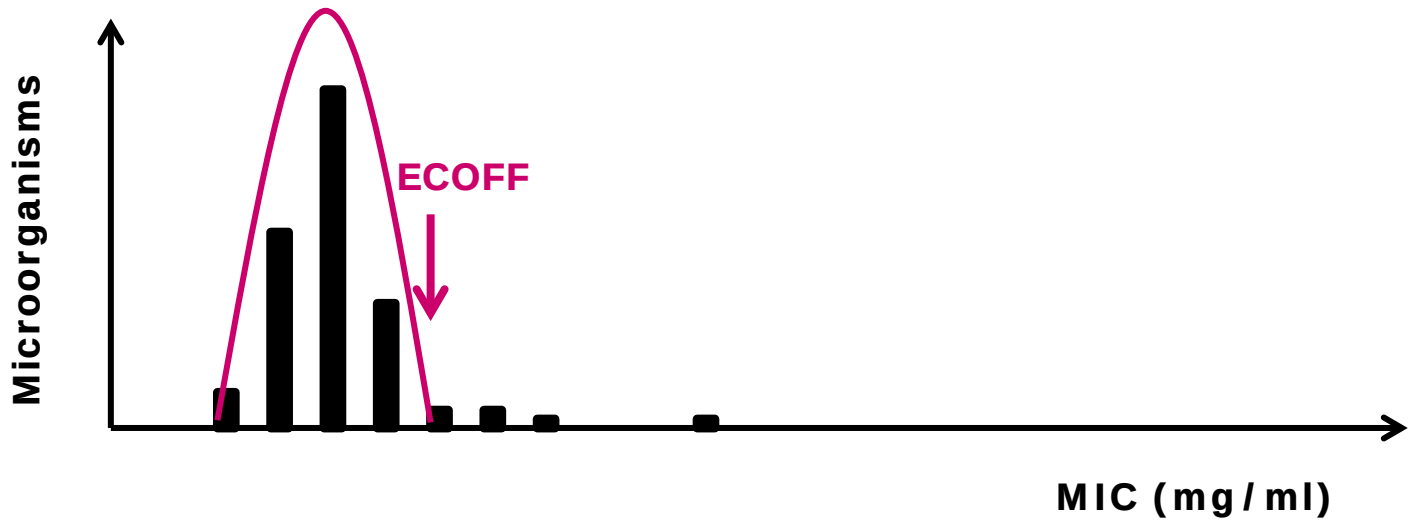
Antibiotic resistance

- Isolate that has a resistance mechanism rendering it less susceptible than other members of the same species lacking any resistance mechanism.
  - Different levels of resistance: low or high level of resistance

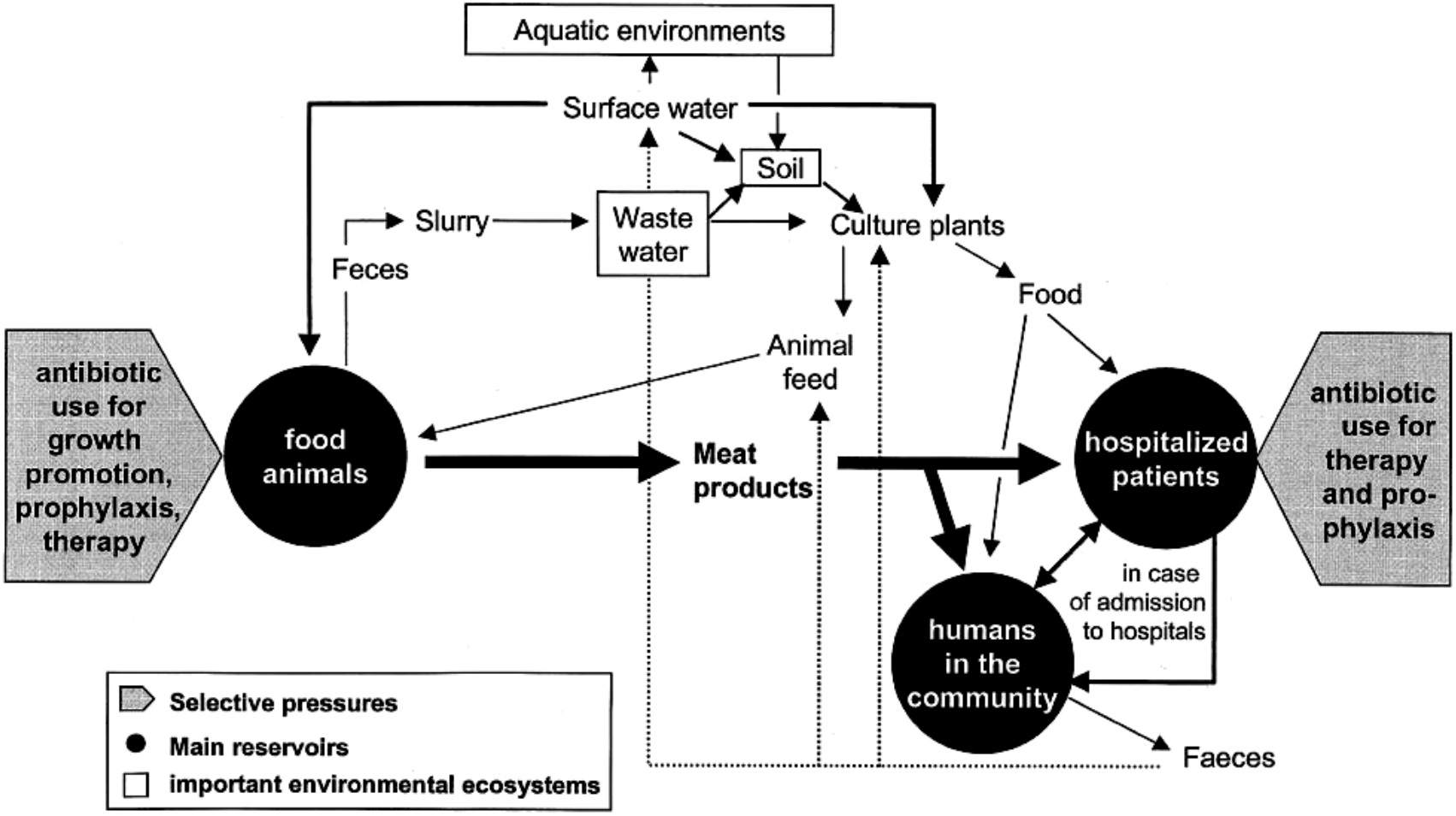
- Clinical resistance (pharmacokinetic/ pharmacodynamic parameters; criteria of cure)

Antibiotics resistance

- Microbiological resistance
- Epidemiological Cut-off (ECOFF) value
- MIC separating the wild-type population/ resistant isolates (mutations, HGT)



Routes of transmission of genes conferring antibiotic resistance.

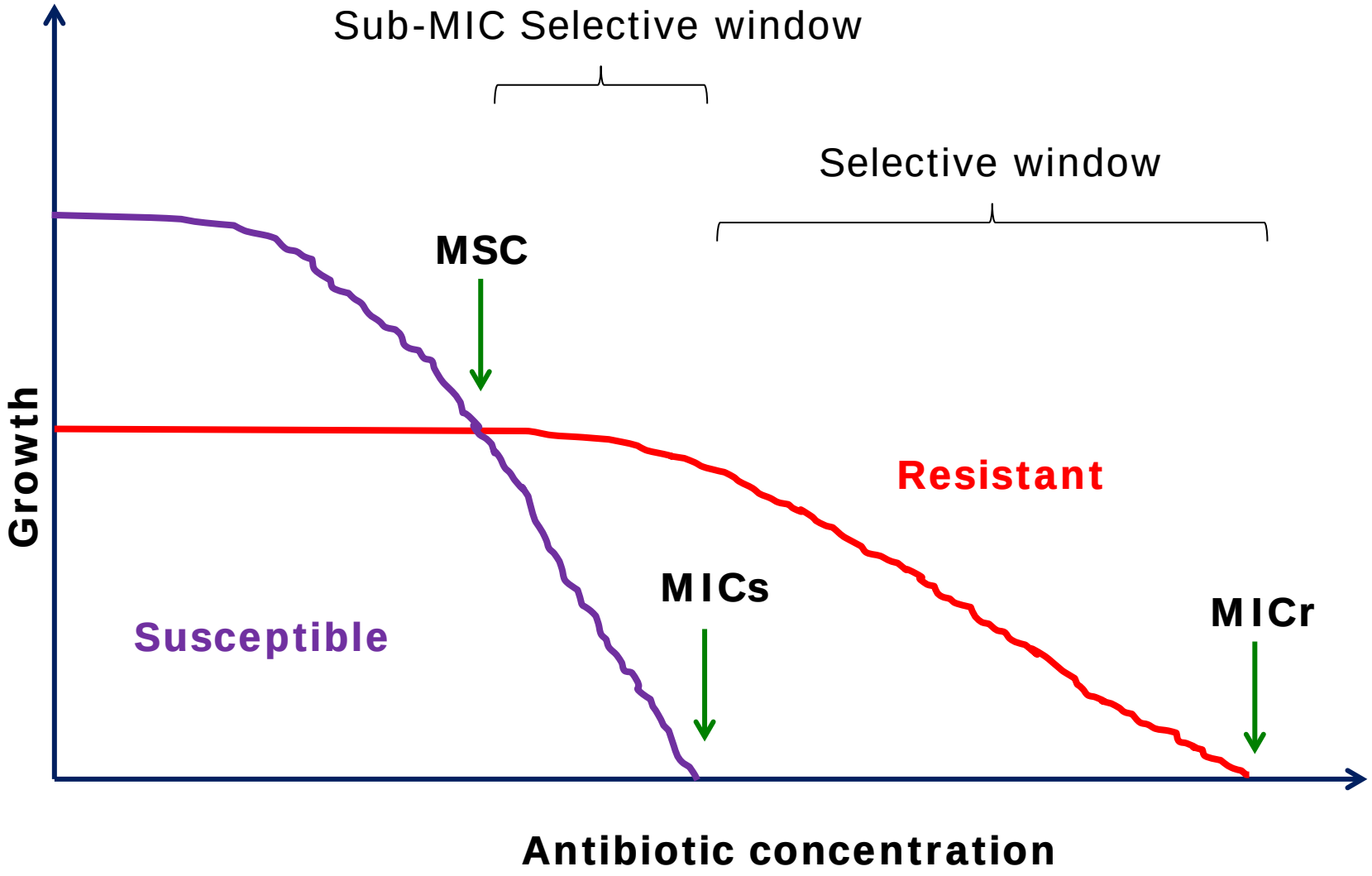


Witte, IJAA 2000

Antibiotic resistance

- Health risks for food producing systems
  - Zoonoses diseases (overuse)
  - Spread of resistance genes to other pathogens of diverse origins (mobile elements...)

Implications on animal and human health; and on the microbial ecology of the environment.



Andersson and Hugues, FEMS 2011.

Antibiotics

- Mutants of *E. coli* and *Salmonella enterica* with resistance to AB (TET, FQ, AG)
  - Selection of R bacteria can occur at AB concentrations up to several hundred-fold below the MIC of the S strains

- Ultralow antibiotic concentrations found in many natural environments are sufficiently high to confer the selection and persistence of antibiotic resistance.

Food production systems

- No frontier for bacterial resistance
- Persistence of AB in environment
- Once acquired, resistant genes are transferred among bacteria of different ecological niches

  (even if no use AB)

Antibiotic resistance

Salmonella spp.

- Resistance in meat: Porc 50-73% ; Chicken 45%
  - Tetracycline, sulphonamide, steptomycin, ampicillin, chloramphenicol, trimethoprim, nalidic acid
- Multiresistance : 21-56% of isolates
  - 7-9 antibiotics: 15% / 10-13 antibiotics: 8%

Campylobacter spp.

- Poulet : 95% des souches sont résistance aux fluoroquinolones (AB critiques)

Escherichia coli : a reservoir

- Resistance: 84% of isolates of beef, poultry, porc
- Multiresistance: Chicken 89%; Porc 75%
- Resistance to fluoroquinolones: 16-21% of isolates, mainly in chicken samples (52-63%)

Garin et al. IJFM 2012; Thi Thu Hao Van et al. IJFM 2012; Truong Ha Thai et al. IJFM 2012; Thi Thu Hao Van et al. AEM 2007; Thi Thu Hao Van et al. IJFM 2008.

Antibiotic resistance

- Multiresistant *Salmonella* from food or food-producing animals are common in different countries:
  - Malaysia 49-75% (n=88)
  - Thailand 44-66% (n=342)
  - Vietnam 21-56% (n=180)

- Multiresistant *E. coli* (n=99) in raw meat (chicken, pork, beef), shellfish and chicken faeces:
  - 89.5% in chicken meat
  - 95% in chicken faeces
  - 75% in pork meat isolates

Van et al. IJFM 2012; Van et al. AEM 2007; Vo et al. 2010

Antibiotic resistance

- Large conjugative plasmids and integrons containing many antibiotic determinants have been found in:

  - *Salmonella* (35% and 13% respectively)
  - *E. coli* (76% and 57% respectively)

  in raw chicken and pork meats from the market place in Vietnam.

Van et al. 2008; Van et al. 2007

Antibiotic resistance

- China: Plasmid-mediated quinolone resistance in *E. coli* isolates from animals, farmworkers, and the farm environment in pig and chicken farms

- Transferable plasmid-mediated multidrug efflux pump gene *oqxAB* which was widespread in animal farms, was also detected in 30% of human commensal *E. coli* isolates from farmworkers without any previous antimicrobial treatment or hospital admission

Zhao, AAC 2010

Conclusion

Surveillance

AB use
Resistance

Decrease AB use

Health management
Reduce disease

Proper use of AB

Diagnostic
Dose / lenght
Molecules

Contamination Control

Hygiene practices
Microbial control

Monitoring / Compliance
Knowlegde / Research
Collaborations

Conclusion

- Research of new antimicrobials with new modes of action
- Rapid methods for detection
- Need for global approaches and strategies because AMR is a global problem